Does Robotic Service Improve Restaurant Consumer Experiences? An Application of the Value-Co-creation Framework

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Abstract

One recent application of technology in the foodservice industry involves robotic services in restaurants, mainly because it reduces labor costs and increases efficiencies. Driven by the value co-creation framework, the purpose of this study was to examine the impact of robot service on restaurant customer experiences and satisfaction. The sample includes a total of 1381 reviews posted from January 2015 to January 2020. This study used the software Leximancer to analyze the data and identified the following themes: Food, Robot, Quality*, Ordering and Delivery Serivces.* The findings further indicated that robotic services play an essential role in creating positive dining experiences and are more likely to lead to higher satisfaction levels. Based on the results, this study discussed how robotic services might contribute to customers' value co-creating process and affect their evaluation of the dining experiences. This study, however, is delimited to English reviews and North American restaurants.

Keywords: robotic services; restaurant; online reviews; value co-creation; customer satisfaction; Leximancer

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Introduction

Robots have become a significant part of our daily lives (Ferreira et al., 2017). In a similar fashion, the hospitality industry has embraced the trend of robots, where various hospitality businesses start to include artificially intelligent robotic devices in their services (Lin et al., 2020). The restaurant sector is probably one of the pioneers in this area as restaurants with robotic services now can be found worldwide, such as the Spyce restaurant in Boston, the Hajime robot restaurant in Japan, and the Robo Sushi restaurant in Toronto. The service provided in robot restaurants ranges from partially to fully automated, depending upon the requirement and features of the restaurant (Hwang et al., 2020; Kuo et al., 2017). Restaurant robots can serve, cook, carry dirty dishes, host visitors, communicate, and even entertain guests (Berezina et al., 2019; Tuomi et al., 2021). It is also believed that having restaurant robots can help reduce operating costs, increase efficiency, eliminate errors, and provide customers with innovative experiences (Tristano, 2018).

Despite the trend of promoting robotic services in restaurants, scant attention has been paid to investigating restaurant customers' perceptions, attitudes, and experiences with robotic services (Tuomi et al., 2021; Zemke et al., 2020). How robots interact with customers and how robot services contribute to the servicescape in restaurants remain unclear. Thus, guided by the value co-creation framework, this study analyzed the content of online reviews on restaurants with robotic services and tried to explore how robotic services affect restaurant customers' dining experiences and satisfaction. Such understanding is not only critical in enhancing our knowledge in this area but also provides significant implications for practitioners regarding the decision of whether implementing robotic services in their establishments. More specifically, this study tries to answer the following research questions:

- What are the key elements that contribute to customers' experience in robotic restaurants?
- How do robotic services contribute to restaurant customers' dining experiences?
- Do robotic services increase restaurant consumers' satisfaction?

Literature Review

An Overview of Research on Robotic Services in Restaurants

As a research topic, robotic services have received increasing scholarly attention in the last five years. Many hospitality scholars have contributed to this area, examining issues such as consumers' attitude and acceptance toward robotic devices (Lin et al., 2020; Murphy et al., 2019), the impact of robotic services on one's branding experiences (Chan & Tung, 2019), and how to design and develop robotic services in hospitality (Berezina et al., 2019; Tuomi et al., 2021). At an operational level, a sizable body of research has investigated robots' capacities in various assistance settings in the foodservice industry, such as working in the back of the house by controlling the alcohol portion in drinks (Komoguchi et al., 2008) and in the front of the house as receptionists, exhibition corridor guides, attendants, and bartenders (Collins et al., 2017; Ivanov & Webster, 2017). Robotic services have also been utilized in the customer service department, taking care of customers' online inquiries and questions (Collins et al., 2017; Ivanov & Webster., 2017).

The travel and hospitality industry began to utilize robots for different assignments like arranging data, cleaning, delivery, serving food and beverages, hosting guests, and so forth (Tuomi et al., 2020). Kuo et al.(2017) found that using service innovation such as robots could directly improve hotel properties' sustainable competitiveness. Similarly, Bowen and Morosan (2018) predicted that around one-fourth of the hospitality jobs in the USA would be computerized mainly by the 2030s. While the

operational and monetary advantages of utilizing service robots in restaurants have gained increasing recognition, scant exploration has been carried out to investigate guests' points of view regarding consuming robotic services in restaurants. One recent study (Zemke et al., 2020) found that quick-service restaurant customers believe in the cleanness and safety aspects of robotic services, but concern about the social impacts and the communication quality. Despite this attempt, most studies concerning robotic services in the hospitality industry either are conceptual in nature (e.g., Berezina et al., 2019) or focus on the hotel sector (López et al., 2013; Tussyadiah & Park, 2018). There is still a lack of empirical research concentrating on robotic services in restaurants, especially the impacts of robotic services on consumer experiences, satisfaction, and subsequent behaviors (Tuomi et al., 2021).

Conceptual Background: The Value Co-Creation Framework

Value co-creation is an emerging framework in customer service research and has gradually replaced the traditional approach, which largely relies on company-centric value creation (Prahalad & Ramaswamy, 2004). The co-creation style "involves [customer] participation in the creation of the core offering itself through shared inventiveness, co-design or shared production of related goods" (Lusch & Vargo, 2006; p. 284). Value co-creation offers unique consumer experiences, mainly because both consumers and producers participate in the product-making process and contribute to the value together (Prahalad & Ramaswamy, 2004). Within the co-creation framework, consumers no longer stay at the end of the value chain; instead, they play a significant role in the production process (Edvarsson et al., 2010). Such engagement leads to consumers' increasing commitment and loyalty, ability to acquire and share product knowledge, and an identity closely associated with the product, the company, and the brand (Denegri-Knott & Molesworth, 2010).

The rapid development of technology has expanded the scope of value co-creation research. Lei et al. (2020), for instance, investigated the value co-creation process through mobile instant messaging, and the findings underscored the solid emotional responses generated from customers. Such findings not only change our traditional interpretation of service encounters, which is typically based on face-to-face interactions but also signify the essence of understanding the value co-creation process between customers and innovative service developments, such as artificial inteliegence and robotic services. By studying service robots in elderly care, Čaić et al. (2018) found that service robots could potentially lead to value co-destruction. In the same vein, through a systematic literature review, Kaartemo and Helkkula (2018) contended that while innovation is a vital area in contemporary service-dominant (SD) rationale studies, innovation-mediated value co-creation is still regularly restricted to a conversation of people as actors. When it comes to hospitality research, the trend of incorporating technology advancements such as artificial intelligence and service robots has become highly noticeable (Bowen & Morosan, 2018; Buhalis et al., 2019; Kuo et al., 2017; Tumoli et al., 2021). It is also noted that the value co-creation framework offers a useful theoretical lens to investigate how service robots may affect hospitality customers' feelings, perceptions, and decision-making (Buhalis et al., 2019).

Vargo and Lusch (2004) point out that a critical aspect of value co-creation lies in customers' active engagement within the service process and their constant contribution to the service value as a co-producer. Traditionally, it is assumed that the value co-creation process mainly takes place through human interactions; recent literature, however, argues that the actors involved in the value co-creation process can be beyond humans and include machines and technologies (Lusch et al., 2016). Consistently, by systematically analyzing the related literature, Kaartemo and

Helkkula (2018) identified four themes that represent the roles played by artificial intelligence and robots in value co-creation, and these themes are (1) generic field advancement, (2) facilitating resource integration between service providers and beneficiaries, (3) supporting the providers, and (4) supporting beneficiaries' well-being.

Another valuable perspective to explore consumer experiences are through online reviews. Online reviews are becoming incredibly popular nowadays because these reviews are generally perceived as more trustworthy, authentic, and transparent; they also significantly affect the readers' purchasing decisions (Zhang et al., 2010). In a similar vein, online reviews are now the primary information sources affecting consumers' decision-making of hospitality products purchases (Ye et al., 2009). Chen and Xie (2008) defined online reviews as "a type of product information created by users based on personal usage experience" (p.477). Kowk et al. (2015) summarize three features of online reviews in hospitality and tourism: (1) the evaluation feature, which is directly reported through the rating and valence of an online review; (2) the reputation feature, which is mainly about the qualification of the user, and (3) the social feature, which facilitates the interactions between the business and consumers.

Similarly, the value co-creation approach has been used to analyze hospitality customers' experiences reported both on-site and online (Chathoth et al., 2013; Shin et al., 2020). Shin et al. (2020) argue that online reviews provide a platform that not only satisfies customers' information needs (i.e., information-seeking and information sharing), but also allows customers to participate in a value co-creation process. Yi and Gong (2013) further specify two types of value co-creation behaviors, including (1) participation behaviors such as information sharing, personal interaction, and (2) citizenship behaviors, such as feedback, advocacy, and helping. The value co-creation framework is especially suitable for hospitality research as most hospitality products

are highly experiential and aim to create and design meaningful and unforgettable hospitality experiences (Chathoth et al., 2014; Shaw et al., 2011). Meanwhile, analyzing the content of online reviews can assist researchers in understanding consumers' various experiences and reflections, including their dining experiences in robot services restaurants (Seyitoğlu & Ivanov, 2020). Despite the significance, very few studies so far have used a value co-creation approach to examine restaurant customers' experiences through the theoretical lenses of value co-creation.

Methodology

Data Collection

Yelp (www. Yelp.com) was selected as the study site since it is one of the biggest consumer-generated review sites for food services, including restaurants (Parikh et al., 2014). The website has around 184 million reviews worldwide and allows users to share their first-hand experiences. These reviews also provide the viewers with a snapshot of the services and quality of restaurants. Yelp users can read and comment on each other's reviews, including what they eat, the amount of money they spent, and their overall experiences. Hennion (2004) described Yelp as a starting point for a "community of beginners" (p. 137). The website enables users to search restaurants by location, price, name, star rating, and services. Once visited, Yelp users are encouraged to leave restaurant reviews and indicate their satisfaction on a five-star rating scale varying from "1 = very dissatisfied" to "5 =very satisfied". The rating function allows researchers to conduct sentimental analyses with restaurant reviews from Yelp (Nakavam & Wan, 2019).

To collect the sample, a search for restaurants with the keyword "robot(s)" in the USA and Canada was performed on Yelp, and reviews posted from January 2015-

January 2020 were included. Seven robotic service restaurants in North America were included in the sample -- six of them were in the USA, and one was in Canada. Regarding the restaurant included in the sample, three of them are full-service restaurants, two of them are coffee bars, one is a quick-service restaurant, and the other one is a cocktail bar. The majority (n=6) are independent restaurants, while one of them is a chain restaurant and has two locations in California. In addition, two of them are ethnic restaurants specializing in Asian cuisine. The number of reviews for each restaurant ranges from 39 to 496, with an average of 197 reviews per restaurant. A total of 1381 reviews were collected by using a data scraping method. Each review serves as a unit of analysis, and each entry includes the content, the rating, and the corresponding restaurant.

Data Analysis

Given the paucity of research in this area, an inductive approach was used to analyze the data through the software Leximancer (V5.0). The inductive approach is data-driven and allows "research findings to emerge from the frequent, dominant, or significant themes inherent in raw data" (Thomas, 2006, p.238). Leximancer uses a machine learning technique that is capable of conducting quantitative content analysis by "transforming lexical co-occurrence information from natural language into semantic patterns in an unsupervised manner" (Ward et al., 2014, pp. 26). Leximancer has been found to create more objective and text-driven reports with sensible and reproducible extractions and theme grouping, even with data sets containing a massive amount of text (Angus et al., 2013; Smith & Humphreys, 2006). Once Leximancer perceives an idea, words that are firmly associated with that idea are highlighted; this technique produces subjects that incorporate explicit social occasions of ideas. Leximancer then transfers these ideas into concepts and themes, all of which are

extracted from the data and are displayed through how they are related to each other (Robson et al., 2013).

This study collected the data and generated a CSV (Comma-Separated Values) file, which was then imported to Leximancer and analyzed through three steps. First, the data was pre-treated by merging words like "robots" & "robotics", "food" & "foods", "delivery" & "delivering." A stemming algorithm was used to complete this process. Second, through automated coding, the software extracted major themes based on word frequencies and generated concept maps that present the connections between themes. The strength of the connectivity between themes was indicated by the probability rate, which ranges from 0 to 100, where 0 means there were no co-relations between the two themes, and 100 signifies strong and positive connectivity. Identifying the major themes and revealing the underlying relationships among these themes directly answered the first two research questions, which aim at exploring consumers' dining experiences and investigating how robotic services may influence their experiences. Lastly, to address the third research question and to further analyze the impacts of robotic services on consumers' satisfaction, we created another concept map by including the valence of theeach review. Follwoing a previous approach (Liu et al., 2016), this study considered both four-star and five-star reviews as positive comments and treated the rest as negative comments. These conceptual maps can directly indicate how robotic services may contribute to their overall evaluation of their dining experiences.

Notably, Leximancer runs an automated analysis based on the text's statistical properties. However, the researchers are highly involved in the data analysis process and capable of interacting with the data (Harwood et al., 2015). More specifically, during the first two steps in this study, the researchers were extensively involved with the data cleaning process. The concepts/themes were reviewed by each researcher independently

and then discussed and verified within the research team. Combining the human intervention and automatic coding process can ensure the credibility and trustworthiness of the qualitative research findings (Lemon & Hays, 2020).

Results and Discussion

Through the theoretical lenses of value co-creation, the purpose of this study was to explore customer dining experiences in robotic service restaurants. Online reviews were used as main data and information sources. This study first delved into a general observation on how restaurant customers describe their dining experience, followed by an investigation on the influences of robotic services on their experiences, and concluded with an exploration on the particular effects of robotic services on their satisfaction and intentions to recommend the restaurant.

What are the key elements that contribute to customers' experience in robotic restaurants?

A total of 66 concepts, which are extracted from the reviews and represent their major content, were generated from the results. All of them are related to each other (See Figure 1). The analysis identified four major themes emerging from the concepts: *Food, Robots, Quality, Delivery Serivcces, Ordering Serivces*. The primary findings here are consistent with previous studies (Seyitoğlu & Ivanov, 2020), suggesting that customers' dining experiences in a robotic service restaurant are reflected through both robotic and non-robotic attributes. Additionally, Zemke et al. (2020) found that in a quick-service restaurant setting, customers are enthusiastic about the novelty aspect of robotic services but worry about the communication quality, the value of human touch, and the potential social impacts. However, these concerns did not emerge in the current study. The inconsistency may be due to the fact that most reviews tend to be confined to their dining experiences at the moment, while additional thoughts were not expressed.

[Please Insert Figure 1 Here]

As expected, *Food* (Hit[1] = 2394) and *Robot* (Hit = 2482) are two major themes revealed by the findings. *Food* occupies the central position of restaurant products. In our sample, the food-related mentions include specific food items, such as burgers, salad bowls, and sushi, as well as the variety of food options. For instance, one review talked about the restaurant providing "*hundreds of food options to choose from.*" *Robot* is another expected theme, as this study mainly concerns consumers' experiences in robotic service restaurants. Most reviews shared their interactions with the robots on-site and underscored the "wow" factor in their experiences. For example, one review wrote, "*Rave! Rave! Rave! Coffee + Robots = wow!*"

Quality (Hit = 1355) is another major theme. It refers to both the food quality (i.e., taste, delicious, fresh) and service quality (i.e., friendly, nice, best). Besides general comments on the quality of service, the review particularly mentioned the *Ordering Services* (Hit = 1948) and *Delviery Serivces* (Hit = 1403). These two themes primarily consider the efficiency of restaurants' services, such as the length of the food preparation time, the speed of food delivery, and how easy it is to use the robotic servicesTo summarize, the primary findings here suggest that despite the uniqueness of robotic service, restaurant customers' experiences are constituted of a wide variety of elements beyond robots.

How do robotic services influence restaurant customers' experiences?

Another focus of this study was to understand how robotic services influence restaurant customers' experiences. To achieve this objective, we further analyzed the relationships between the theme *Robot* and other concepts with the theoretical lenses of

[1] Hit refers to the "number of text blocks associated with the theme" and indicates the frequency of the theme (Leximancer, 2020).

value co-creation. The results showed that *Robot* is associated with the following concepts: *Table, Making (Food Production), Watch, Human, Cool, and Experience*. The concepts *Table* and *Making (Food Production)* describe the major responsibilities of robots in the restaurants in the sample, such as food preparation, table setting, and food delivery. This is consistent with Kaartemo and Helkkula's (2018) argument, suggesting that robots can co-create value by supporting service providers. Some customers were fascinated by the automatic sensors of robots, sharing the moment when *"(a robot) stops when someone walks by/in front of them*." A lot of them also described how the robots made various types of beverages, including cocktails and coffee. Interestingly, the emergence of the theme *watch* suggests that most customers were passively engaged in the food production process, as they were mainly "*seeing how their foods were prepared by a robot*." One review, for instance, described the whole process as, "*simply place your order for a drink at the kiosk and watch as the robotic arm makes your drink*." Despite its passive nature, these notions explicate customers' participation behavior during the value co-creation process (Yi & Gong, 2013).

The concepts *Cool* and *Experience* offer more insights into customers' feelings about how robotic services affect their overall experience at the restaurant. They described their experience as "*fun,*" "*entertaining,*" and "*cool*." As one review depicted, *"seeing your food prepared by a robot is even cooler than it sounds."* Similarly, another review commented that "(*Restaurant A) is definitely worth the experience alone."* One of the most exciting findings we noticed here is that the robotic service experience is so unique that it can even make up for the disappointment toward poor food quality on some occasions. As one review reflected, *food isn't great at all! You're really just paying for the experience of the robot serving you."* A similar observation has been noted from a previous study, which argues that tourists tend to find robots in eateries new and exciting,

which is fundamental in their memorable experiences (Kim et al., 2012). The highlighted affective dimension not only indicates the level of customers' excitement but also explains how robotic services connect the customers with the service providers, which is another key function of robots in co-creating values (Kaartemo & Helkkula, 2018).

The themes of *Human* and *Robot* are found strongly correlated. Although most customers passively participated in the service produce process provided by robots, the strong connection between customers and robots best exemplifies the value-cocreation process. This process is mainly reflected through customers' enjoyment of robots' personal touches. One customer shared his/her experience, saying that "*the robot displays your name or whatever name you give while it's making your food, so you can have some fun with that*!" In addition to the joy of being properly addressed, robots' personal touches can make a customer feel respected, supported, and even empowered. One customer shared his/her experience, writing that *"the lid was labeled with my name (with little rainbows beside it!! If robots can celebrate pride, why can't all humans, too?"* Although it is widely acknowledged that robots cannot simply replace human workers in the foodservice industry, the connection we observed here does suggest that customized products created by robots not only satisfy customers' basic needs but also can elevate their experiences and generate positive emotional responses.

Do Robotic Services lead to higher satisfaction?

Lastly, this study tried to investigate if robotic service can lead to higher satisfaction and/or stronger purchasing intentions. According to Yi and Gong (2013), customers' contribution to the value co-creation process can be represented through two types of behaviors – the participation behavior and the citizen behavior. The participation behaviors were reported earlier through their on-site experiences, and the citizen behavior was assessed through their satisfaction, restaurant advocacy, and critical feedback.

From previous analyses, it seems that most customers were *"happy," "satisfied,"* and even *"fascinated"* by robotic services. Many of them visited the restaurants due to recommendations from friends and family and stated that they would "*definitely come back*." To build a stronger argument, we generated another conceptual map by running sentimental analysis and including review ratings. The results are shown in Figure 2. The red tags report the valence of the reviews, and the distance between the rating and the concepts/themes indicates the strength of the relationship, where a closer distance signifies a stronger correlation. More specifically, the results revealed that the theme *Robot* is strongly correlated with positive reviews. This indicates that the appearance of the robotic service is playing a "supportive" role in customers' satisfaction. A closer examination of the the reviews reveals that most positive comments are associated with customers' fascination with robots and their enjoyment of the innovative concept. For example, one review says that *"Such a cool concept! Having a robot essentially prep, cook and serve the food - so efficient."* Consistent with previous observations, these reviews were so enthusiastic over the robotic services that they tend to oversee the quality of the food, leaving a satisfactory rating even with comments such as *"not bad,"* and *"the food was good, but I can't call it great."*

[Please insert figure 2 here]

The satisfaction of the robotic services can be ascribed to their innovative essence, service efficiency, and highly customized products. As Yrjölä et al. (2019) suggest, both fast service and supportiveness are the key to producing high service quality in restaurant experiences. As illustrated in Figure 2, the positive reviews were more closely linked with *Food*, suggesting that customers still prioritize the product and value from foodservice operations. This finding is consistent with previous research that consumers care most about food and value in restaurants (Ma et al., 2011). The presence of robotic services is

more like an add-on to restaurant service, leading to a more innovative and satisfying dining experience. The results of the current study somewhat reflect the finding from a previous study, suggesting that robotic service in restaurants hedonically motivated customers and has a positive impact on the image of the restaurant (Hwang et al., 2020).

Conclusions

This study mainly explores customers' experiences at a robotic service restaurant using a value co-creation approach. As showed in Figure 3, restaurant customers' dining experiences are reflected through both robot- and non-robot-related elements, such as food, service, and overall quality. Further analysis of their accounts indicates that, despite the passive participation, most customers perceive the value of the robot-provided restaurant products through the increased efficiency of services as well as highly customized products. These positive interactions lead to various outcomes, including a higher level of satisfaction, a stronger revisiting intention, as well as the desire to share the restaurant with their friends and other Yelp users. The combination of their information-sharing behavior and grassroots advocacy explicates how consumers contribute to the value creation process as co-producer (Yi & Gong, 2013).

[Please Insert Figure 3 Here]

Additionally, the results showed that, overall, robotic services are among the major topics among these reviews. The robot was seen closely associated with themes such as food and quality. Also, the robot was closely related to some positive concepts, such as "cool" "watch", "making" and more. Consumers felt engaged and part of the process while they were waiting for their food. They enjoyed the process of the robot guiding them to the table, which made them happy. Besides, a restaurant that had robots preparing food, consumers engaged by looking at the process and admiring it. It was seen the consumers not only consumed the food but also participated in the process, which was

seen as elevating value co-creation. In general, robotic services are associated with positive comments. Consistent with the literature (Kaartemo & Helkkula, 2018), all these notions specify robots' contribution to the value co-creation process by (1) satisfying the needs of service providers, (2) increasing the efficiency of the equipment, (3) connecting the service providers and customers, and (4) enhancing the customers' emotional well-being.

Theoretical Implications

By analyzing a large number of user-generated reviews related to robotic service on Yelp.com, the results of this study contributed to the literature by identifying the major topics that are of interest to restaurant customers. Compared with traditional studies that use surveys (Hwang et al., 2020), the current study represents opinions of a greater population on a restaurant review site while at the same time avoiding the selection bias associated with small or convenience samples (Grimmer, 2015). Additionally, using the machine learning software Leximancer to analyze the dataset allows us to uncover topics underlined in restaurant reviews without being impacted by researchers' assumptions made according to the previous literature or researchers' prior knowledge about this topic (Grimmer, 2015). Lastly, the findings of this study provide empirical support of the pragmatic utility of the value co-creation framework, which demonstrates the contribution of robots and customers to the value co-creation process within an innovative domain that involves robotic service in restaurants.

Practical Implications

Despite the costs related to investing and including robotic serves in restaurants, it remains unclear if robotics services are becoming a major trend or appear to be temporary. Regardless, the findings of this study provide meaningful implications for foodservice managers and operators regarding the decision to incorporate robotic services

in their establishments. First, the findings of this study show that robotic services have a general positive influence on consumer experiences by co-creating a special value in their dining experiences. It also enhances their satisfaction. However, the extent of the influence is affected by the quality and price of the food, which is evidenced by the fact that negative reviews mainly complain about poor food quality. In other words, service robots may lead to customer satisfaction but rarely result in customer dissatisfaction. Therefore, restaurants with robotic services should focus on their food quality and take measures to improve food quality, which is the most essential part of their product. With the satisfactory foods provided, the benefits of robotic services can be maximized.

Next, this study shows that robots occupy a central role in defining one's dining experience in the sample. Therefore, restaurant managers need to pay special attention to the value co-creation experience and enhance customers' positive involvement with robotic services. This can be achieved by addressing the human touch element and delivering personalized and customized products. Highlighting such interactions between robots and customers should be one of the most important future directions of using robotic services in the restaurant industry.

Lastly, the findings of this study show that robotic services are generally considered innovative, which is a key attracting element for customers; this is consistent with the findings of a previous study (e.g., Zemke et al., 2020), which found that innovation is one of the positive traits associated with robotic services. Robotic service may not work for all restaurants but definitely fit for quick-service restaurants with customers who favor fast, efficient, and accurate service or those restaurants whose target customers are innovative experience seekers.

Before COVID, the decision-making process of adopting robots mainly relies on saving labor-cost and building an innovative image for the restaurant. Due to the COVID-

19 pandemic, many restaurants are finding ways to deliver foods with minimal contact or non-contact to combat virus transmission. Robotic services seem to cater to such emerging needs. The utilization of robots reduces the involvement of human beings in food preparation and service and thus, satisfies the requirements of social distancing and food safety and hygiene standards.

Limitations and Future Research

This research surely has limitations. First, our study only concerned restaurants in North America, and all reviews were in English. Restaurants in other areas such as Europe or Japan were not included. Future research should expand the horizon and include restaurants in other areas. Second, this study noticed the positive relationship between robotic services and a higher level of satisfaction among restaurant customers. Future studies can explore further and specify what type of robots/robotic services is more likely to increase customer satisfaction. Third, this study only analyzed the user-generated comments about robotic service on one restaurant review website. Future studies may incorporate a broader range of data and explore the determinants of customer satisfaction using big data analytics. Fourth, although user-generated content is generally perceived as authentic and reliable, it is noted that Yelp reviews may not always be trustable (Loten, 2014). Therefore, future studies can replicate this research on different sources (i.e., Twitter, TripAdvisor) and compare the findings. Fifth, this study primarily focused on the North American market; however, market differences exist by region, especially considering that Canada is regarded as a very high multicultural country and the consumers' cultural background may have different implications than USA counterparts. Empirical studies, therefore, are very much needed in future studies to explore these dissimilarities further. Lastly, the data of this study was conducted before the Covid-19 pandemic. Although the findings of this study can provide implications on the benefits of

using robotic services in restaurants, this study did not directly capture customers' experiences during the pandemic. Future studies can fill this gap and examine if robotic services can contribute even more to the restaurant business during the pandemic and the recovery phase.

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